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TITLE: **CDMA** transmit peak power reduction

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INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP
CODE COUNTRY			
McGowan; Neil	Stittsville	N/A	N/A
CA			
Jin; Xin	Nepean	N/A	N/A
CA			

US-CL-CURRENT: **455/522**, 375/296 , 455/127.1

ABSTRACT:

    A peak power regulator is disclosed that functions within a Code Division
Multiple Access (**CDMA**) transmitter to reduce peak power spikes within baseband
signals while maintaining the **average** output power consistent with the **average**
input power, controlling the out-of-band emissions, and maintaining the in-band
signal quality within an acceptable degradation. In-phase and quadrature
baseband signals are input to a delay block and an envelope magnitude predictor
within the peak power regulator. The envelope magnitude predictor outputs an
estimate for the magnitude of the envelope that will be generated when the
inputted baseband signals are modulated. This **estimate** is input to a
multiplier that generates a ratio by dividing the **estimate** by a maximum
acceptable envelope magnitude. The ratio is subsequently input to a mapping
table that outputs a scaling factor sufficient for reducing peak power spikes.
The scaling factor is subsequently input to an optional mean power regulator
that generates an instantaneous gain value sufficient to maintain the **average**
output power level at the **average** input power level. This gain value is
applied to two **multipliers** that are also input with delayed versions of the
in-phase and quadrature baseband input signals. The outputs from these two
multipliers, after being filtered within lowpass filters to remove

out-of-band
emissions caused by the scaling, are output from the peak power
regulator.
These peak power reduced outputs have any peak power spikes scale
reduced while
maintaining the **average** power constant.

13 Claims, 11 Drawing figures

Exemplary Claim Number: 1

Number of Drawing Sheets: 8

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Abstract Text - ABTX (1):
   A peak power regulator is disclosed that functions within a Code
Division
Multiple Access (**CDMA**) transmitter to reduce peak power spikes within
baseband
signals while maintaining the **average** output power consistent with the
average
input power, controlling the out-of-band emissions, and maintaining the
in-band
signal quality within an acceptable degradation. In-phase and
quadrature
baseband signals are input to a delay block and an envelope magnitude
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within the peak power regulator. The envelope magnitude predictor
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estimate for the magnitude of the envelope that will be generated when
the
inputted baseband signals are modulated. This **estimate** is input to a
multiplier that generates a ratio by dividing the **estimate** by a maximum
acceptable envelope magnitude. The ratio is subsequently input to a
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table that outputs a scaling factor sufficient for reducing peak power
spikes.
The scaling factor is subsequently input to an optional mean power
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that generates an instantaneous gain value sufficient to maintain the
average
output power level at the **average** input power level. This gain value
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applied to two **multipliers** that are also input with delayed versions of
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in-phase and quadrature baseband input signals. The outputs from these
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multipliers, after being filtered within lowpass filters to remove
out-of-band
emissions caused by the scaling, are output from the peak power
regulator.
These peak power reduced outputs have any peak power spikes scale
reduced while

maintaining the **average** power constant.

TITLE - TI (1):
   CDMA transmit peak power reduction

Brief Summary Text - BSTX (4):
   The use of Code Division **Multiple** Access (**CDMA**) technology is increasing
within wireless applications such as cellular and Personal Communication
Systems (PCS). Its utilization will continue to be significant as **CDMA**
technology is incorporated within new standards such as the third generation
(3G) Direct Spreading (DS)-**CDMA** communication system currently being defined.
In **CDMA** technologies, **multiple** users and/or **multiple** data streams of each user,
which each transmit information on a **different** code channel, share the same
frequency channel, hereinafter referred to as a carrier. Furthermore, **CDMA**
transmitters may also utilize **multiple** carriers, and therefore, **multiple CDMA**
carriers share the same power amplifier and other components within a
particular transmitter. This sharing of carriers between users and/or the
sharing of power amplifiers and other components between carriers cause
compounded signals to have a high Peak to **Average** Power Ratio (PAPR) to be
processed by said components. In the 3G DS-**CDMA** standards, **multiple** code
channels share the same carrier within 3G mobile stations. Hence, similar to
that for a base station, compounded signals with potentially high PAPR are
input to the power amplifiers of 3G mobile stations.

Brief Summary Text - BSTX (5):
   In order to meet the out-of-band emissions requirements, a power amplifier   。
and other components with this high PAPR input is required to provide good
linearity in a large dynamic range. This makes the power amplifier one of the
most expensive components within the communication system. The high PAPR also
means that the power amplifier operation has low power efficiency. When
considering the 3G DS-**CDMA** case, this low power efficiency reduces the battery
life time for 3G mobile stations.

Brief Summary Text - BSTX (6):
    An apparatus is thus needed that can reduce the PAPR of **CDMA** signals
input
to power amplifiers. Such a device should reduce the peaks of the
compounded
input signals such that a less expensive power amplifier can be
utilized with
out-of-band emissions still being fully controlled. This device should
also be
relatively inexpensive and any degradation in terms of in-band signal
quality
should be within an acceptable range.

Detailed Description Text - DETX (2):
    Although the preferred embodiment of the present invention described
herein
below is incorporated within a **CDMA** transmitter, the present invention
is not
limited to such an implementation, but for example can be utilized in
any
transmitter in which peak power reduction and control of out-of-band
emissions
is required.

Detailed Description Text - DETX (3):
    A single channel **CDMA** transmitter using a Baseband Peak Power
Reduction
(PPR) block according to a preferred embodiment of the present
invention is now
described with reference to FIG. 1. A Data Source (DS) 102 generates
data
streams 104 for transmission on multiple code channels corresponding to
multiple users and/or multiple data streams for each user. These data
streams
104 from the DS 102 are encoded, spread, and combined within a Channel
Encoder
and Spreader (CES) 106 which outputs an in-phase (I) baseband signal
108 and a
quadrature (Q) baseband signal 110. The I and Q baseband signals
108,110 are
then pulse shaped by a Baseband Pulse Shaping Filter (BPSF) 112 that
outputs
pulse shaped I and Q baseband signals 114,116 to a Baseband PPR block
118. The
output from the Baseband PPR block 118 are peak power reduced baseband
signals
120,122 which are subsequently modulated within a Quadrature Modulator
(QM)
124. The output signal 126 from the QM 124 is input to an Up-Converter
(UC)
128 which shifts the frequency of the signals to the desired
transmitting
frequency. The up-converted signal 130 output from the UC 128 is input
to
Power Amplifier (PA) 132. .The output signal 134 from the PA 132 is

filtered by
an RF Filter (RFF) 136 before being transmitted to the air through an
antenna
138.

Detailed Description Text - DETX (5):
    FIG. 2 illustrates the preferred embodiment of the Baseband PPR
block 118
implemented within the single carrier transmitter depicted in FIG. 1.
This
Baseband PPR block 118 utilizes nonlinear baseband processing to
instantaneously scale the pulse shaped I and Q **CDMA** baseband signals
114,116 to
within an acceptable threshold range. The scaling of the baseband
signals
results in the envelope of modulated **CDMA** signals being equivalently
scaled to
a pre-configured magnitude threshold after quadrature modulation.

Detailed Description Text - DETX (7):
    The squared envelope magnitude predictor 202, which is equivalent to
a power
estimation apparatus, estimates the squared magnitude of the modulated
CDMA
waveform envelope that would be formed by the baseband signals 114,116
after
quadrature modulation, hereinafter referred to as the squared envelope
magnitude, and outputs a signal representative of this squared envelope
magnitude. The squared envelope magnitude predictor 202, according to
this
preferred embodiment of the present invention, comprises a first
squarer 216
that multiplies the I baseband signal 114 by itself, a second squarer
218 that
multiplies the Q baseband signal 116 by itself, and an adder 220 that
sums the
outputs of the first and second squarers 216,218. The output from the
adder
220 is a squared envelope magnitude corresponding to the baseband
signals
114,116.

Detailed Description Text - DETX (19):
    A multi-carrier **CDMA** transmitter, according to another preferred
embodiment,
using a Baseband PPR block is now described with reference to FIG. 3.
The
multi-carrier transmitter is similar to the single carrier transmitter
depicted
within FIG. 1, but the multi-carrier transmitter includes a plurality
of
pre-modulation carrier paths. In the example shown in FIG. 3, a
transmitter
with three carriers is depicted, though this is not meant to limit the

scope of
the present invention.

Detailed Description Text - DETX (49):
   There are numerous advantages gained within the transmitter that
utilizes a
PPR block according to the present invention. The PPR block scales
down the
peak power periods while, in the preferred embodiments, maintaining the
average
power level, therefore reducing the **CDMA** Peak-to-Average Power Ratio
(PAPR).
This reduced PAPR is the most significant advantage of the present
invention
and results in the PA, within the transmitter, being capable of
operating at
higher average power levels while still satisfying the out-of-band
emissions
requirements.

Claims Text - CLTX (5):
   5. A **CDMA** transmitter comprising: a data source coupled in series
with a
channel encoder and spreader, a baseband pulse shaping filter, and a
quadrature
modulators; an envelope magnitude regulator according to claim 4 input
with
the output from the quadrature modulator, the output from the
quadrature
modulator corresponding to the IF input signal; and an up-converter,
input
with the IF output signal, coupled in series with a power amplifier, a
radio
frequency filter, and an antenna.

Claims Text - CLTX (6):
   6. A **CDMA** transmitter comprising: a plurality of data sources
coupled in
series with a plurality of channel encoder and spreaders, a plurality
of
baseband pulse shaping filters, and a plurality of quadrature
modulators; a
combiner, that combines the outputs from the quadrature modulators; an
envelope magnitude regulator according to claim 4 input with the output
from
the combiner, the output from the combiner corresponding to the IF
input
signal; and an up-converter, input with the IF output signal, coupled
in
series with a multi-carrier power amplifier, a radio frequency filter,
and an
antenna.

Claims Text - CLTX (12):
    12. A **CDMA** transmitter comprising: a data source coupled in series
with a
channel encoder and spreader, a baseband pulse shaping filter, and a
quadrature
modulator; an envelope magnitude regulator according to claim 11 input
with
the output from the quadrature modulator, the output from the
quadrature
modulator being the IF input signal; and an up-converter, input with
the IF
output signal, coupled in series with a power amplifier, a radio
frequency
filter, and an antenna.

Claims Text - CLTX (13):
    13. A **CDMA** transmitter comprising: a plurality of data sources
coupled in
series with a plurality of channel encoder and spreaders, a plurality
of
baseband pulse shaping filters, and a plurality of quadrature
modulators; a
combiner, that combines the outputs from the quadrature modulators; an
envelope magnitude regulator according to claim 11 input with the
output from
the combiner, the output from the combiner being the IF input signal;
and an
up-converter, input with the IF output signal, coupled in series with a
multi-carrier power amplifier, a radio frequency filter, and an
antenna.

Current US Original Classification - CCOR (1):
    455/522

US-PAT-NO: 6144860

DOCUMENT-IDENTIFIER: US 6144860 A

TITLE: System and method for controlling transmission
power

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Detailed Description Text - DETX (43):
   The **multiplier** 41 **multiplies** a pilot symbol by an **estimated** fading
vector.
In the fading vector **estimation,** the phases are justified by
multiplying a
pilot signal by a complex conjugate of a theoretical value of the pilot
signal.
Then, the composition of vectors in the same phase is performed. The
resultant
vector is **averaged** with the composite symbol number. A current fading
can be
estimated by performing a high-order interpolation using past fading
vectors.

Current US Original Classification - CCOR (1):
   455/522